Description and qualitative analysis of flood risk drivers and responses

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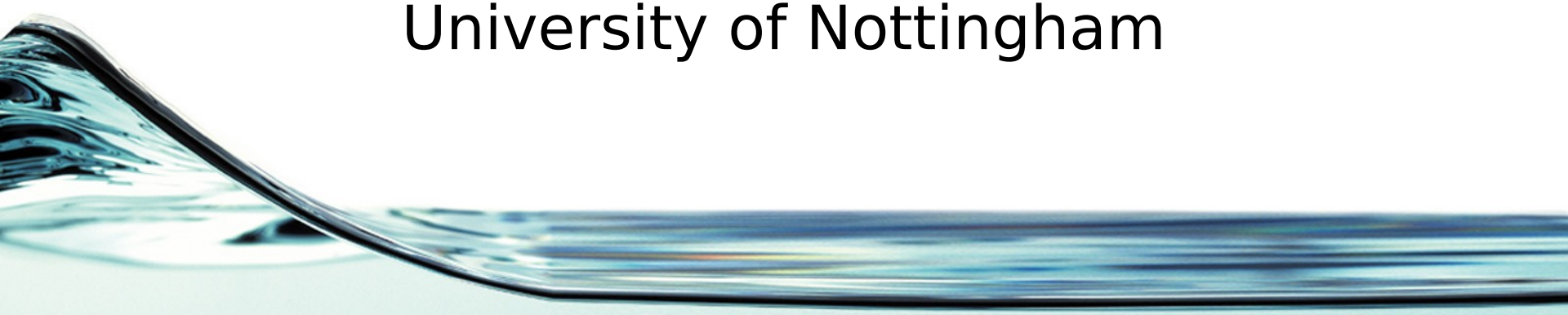


Outline

DRIVERS OF FUTURE FLOOD RISK
- Grouping the Drivers
- Deep Driver Descriptions
- Qualitative Analysis of Drivers
- Driver Impact Scoring
- Driver Ranking and Uncertainty

RESPONSES TO FUTURE FLOOD RISK
- Grouping the Responses
- Deep Response Descriptions
- Qualitative Analysis of Responses
- Response Impact Scoring
- Response Ranking and Uncertainty

Grouping the Drivers

*Drivers were arranged into **functional driver groups** for treatment by specialist teams:*

- Drivers in a functional driver group operate in a similar manner or in a common sector of the flooding system;
- Interactive links between drivers within a group are more direct and/or stronger than those between drivers in different groups;
- Each Functional Driver Group can be dealt with by a small team of specialists working semi-independently.

Functional Driver Groups (1)

Driver Group	Drivers	S/P/R	
Climate Change	**Precipitation**	**Source**	
Temperature	**Source**		
Catchment Runoff	Urbanisation	Pathway	
Rural Land Management	Pathway		
Agricultural Impacts	Receptor		
Fluvial (River) Systems	Environmental Regulation		Pathway
Morphology and Sediment	Pathway		
Vegetation and Conveyance	Pathway		

Functional Driver Groups (2)

Driver Group	Drivers	S/P/R
Coastal Processes	Waves	Source
	Storm Surges	Source
	Relative Sea Level Rise	Source
	Morphology and Sediment Supply	Pathway
Human Behaviour	Stakeholder Behaviour	Pathway
	Public Attitudes and Expectations	Receptor
Socioeconomics	Buildings and Contents	Receptor
	Urban Impacts	Receptor
	Infrastructure Impacts	Receptor
	Social Impacts	Receptor
	Science and Technology	Receptor

Deep Driver Descriptions

For each Driver a specialist team was tasked to:

- thoroughly describe the **character and operation** of the driver;
- illustrate, using a **case example**, the different types of driver change, their operational impacts and flood risk consequences.

For each Driver Group the specialist team was tasked to:

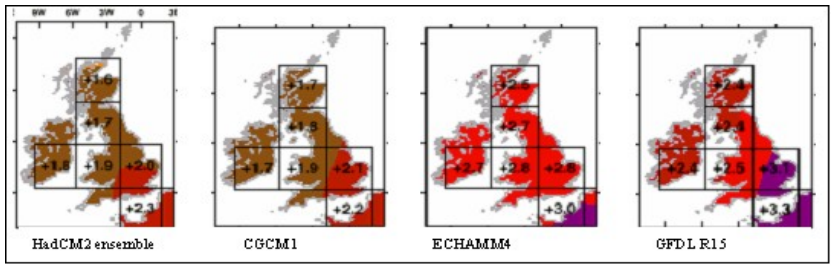
- investigate and understand crucial **driver linkages and interactions** within that Driver Group and between it and other Driver Groups;

Deep Driver Descriptions

- Driver Definition
- Driver Operation
- Regional Patterns and Exceptional Locations (inc. maps if appropriate)
- Driver Importance
- Uncertainty
- Case Example(s)
- Bibliography (up to 6 KEY authoritative references and sources)

Example: 'Climate Change' Group

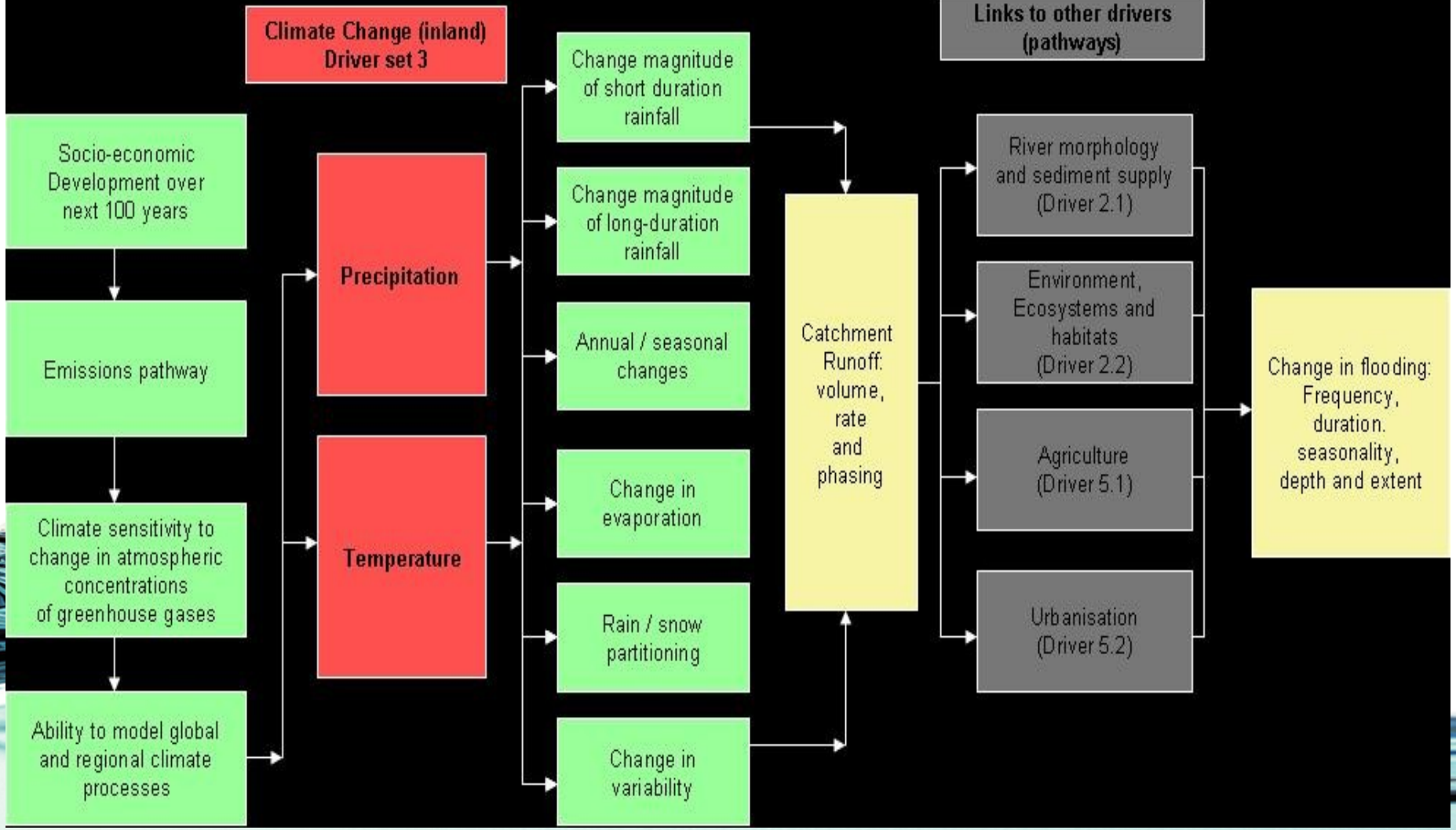
- Precipitation
  - Rainfall
    - Annual / seasonal change
    - Long / short duration
    - Variability
  - Snowfall
    - Estimating impacts of changes on flood risk
- Temperature
  - Precipitation
  - Evapotranspiration



Functional Driver Group Descriptions

- Description of the Functional Driver Group
- Driver-Impact Feedback Loops
- Interaction between Drivers
- Interaction with other Driver Groups
- Bibliography (up to 6 KEY authoritative references and sources)

Climate change - driver interactions


Climate Change (inland) Driver set 3
Socio-economic Development over next 100 years
Emissions pathway
Climate sensitivity to change in atmospheric concentrations of greenhouse gases
Ability to model global and regional climate processes
Precipitation
Temperature
Change magnitude of short duration rainfall
Change magnitude of long-duration rainfall
Annual / seasonal changes
Change in evaporation
Rain / snow partitioning
Change in variability
Catchment Runoff: volume, rate and phasing
Links to other drivers (pathways)
River morphology and sediment supply (Driver 2.1)
Environment, Ecosystems and habitats (Driver 2.2)
Agriculture (Driver 5.1)
Urbanisation (Driver 5.2)
Change in flooding: Frequency, duration. seasonality, depth and extent

Qualitative Analysis of Drivers

For each Driver the specialist team was tasked to:

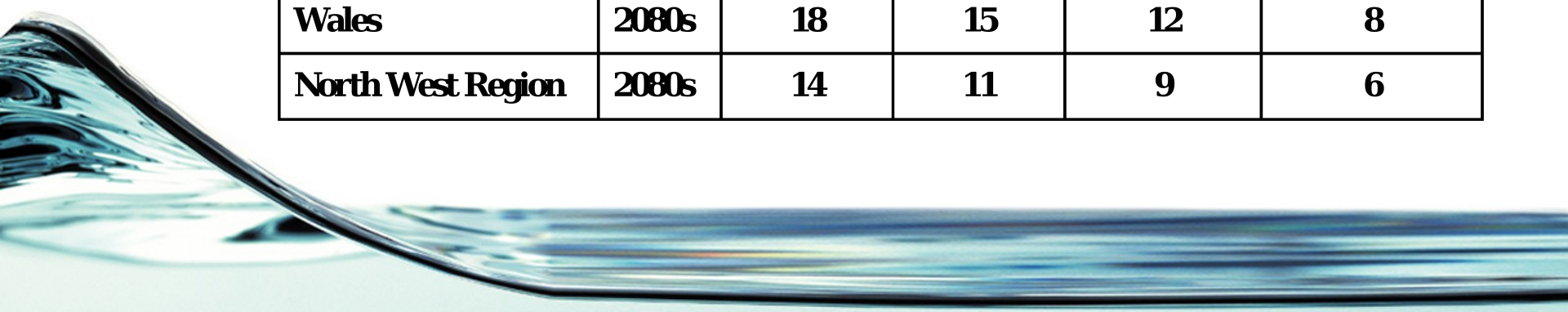
- Identify likely driver changes under each Future Scenario for the UK over the next 30-100 years;
- Select a 'native parameter' to represent each driver. This is an entity, measure or metric used to express driver change under each future scenario. (Note: native parameters may be *numerical* or *textual);*
- Estimate the driver impact on national flood risk in the 2050s and 2080s resulting from changes in native parameters;
- Consider the sources and levels of uncertainty in driver changes;
- Trace uncertainties through to the estimates of flood risk impact;
- Rank the drivers based on their impacts on national flood risk and uncertainty concerning those impacts.

Example: Climate Change + World Markets/High Emissions

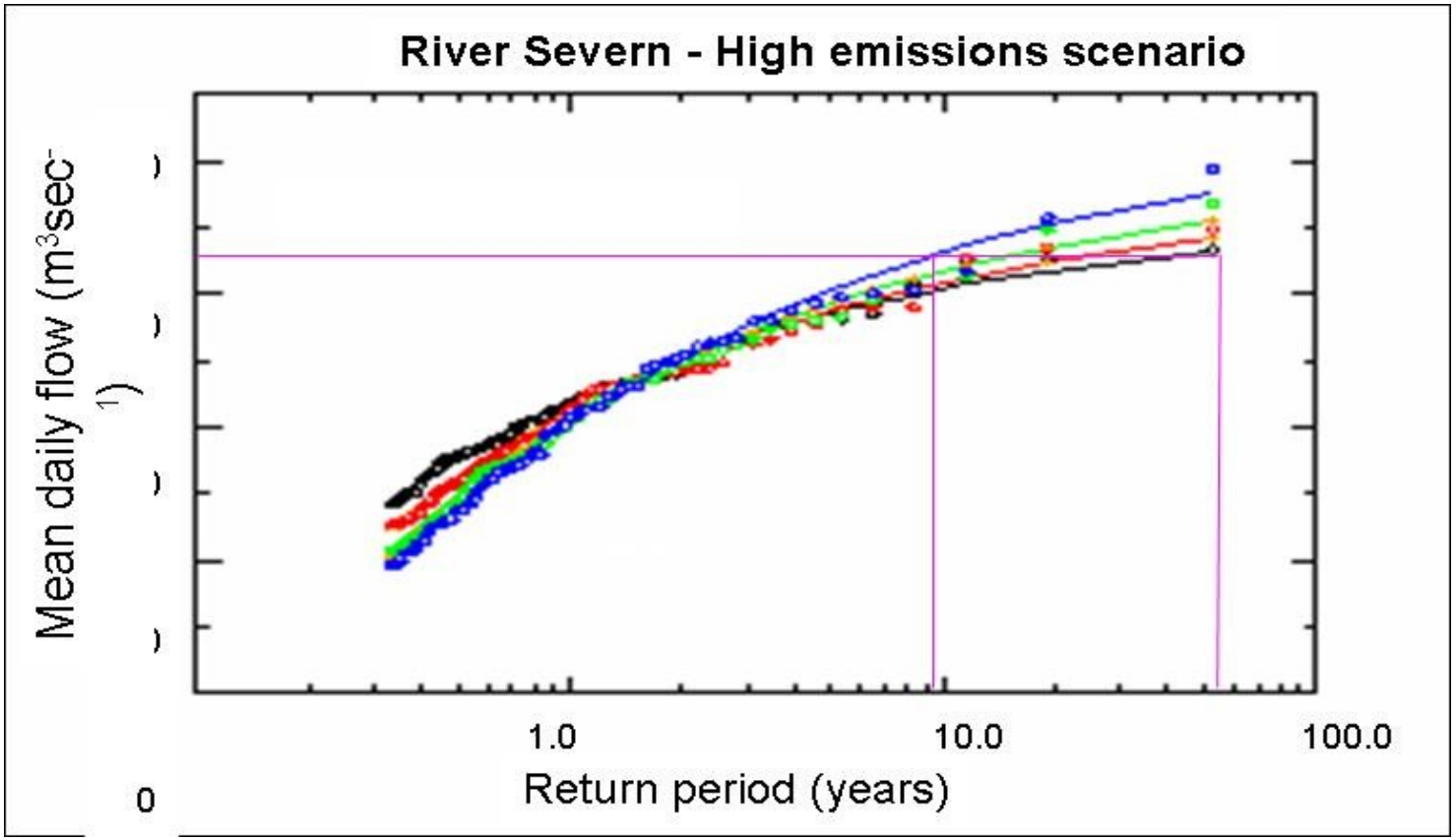
Driver	Driver Name	Change in Native Parameter	
		2050s	2080s
1-S	Annual precipitation	-5%	-8%
1-S	Winter precipitation	15%	25%
1-S	Summer precipitation	-30%	-50%
1-S	Rainfall intensity – winter	12%	20%
1-S	Rainfall intensity – summer	-18%	-26%
1-S	Temporal sequencing	6%	12%
1-S	Snow	-40%	-80%
1-S	Soil moisture – summer	-20%	-40%
1-S	Spatial extent	Increase	Increase
4-S	Average winter	1.5ºC	2.5ºC
4-S	Average summer	2.5ºC	4ºC

Example: Climate Change: Percentage change in peak flows in 2080s

Hydrometric region		World Markets	National Enterprise	Local Stewardship	Global Sustainability
Northern Scotland	2080s	25	21	16	12
Southern Scotland	2080s	30	25	20	15
Northumbrian	2080s	11	9	8	7
River Trent	2080s	10	8	7	5
Anglian Region	2080s	6	5	4	3
River Thames	2080s	2	1	-1	-3
Southern Region	2080s	-12	-10	-8	-6
South West Region	2080s	14	11	9	6
Wales	2080s	18	15	12	8
North West Region	2080s	14	11	9	6



Example: Converting peak flows to flood probability



Current 50-year event = 680m³s⁻¹ flow
2080s High 680m³s⁻¹ flow = 10-year event

5 fold increase in flood risk

Driver Impact Scoring (1)

Driver impacts were expressed as a multiplier of the current national flood risk associated with that Driver:

Risk as a multiplier of risk under current conditions	Qualitative Description
32×	Exceptional increase in flood risk
16×	Extreme increase in flood risk
8×	Very large increase in flood risk
4×	Large increase in flood risk
2×	Significant increase in flood risk
1×	No change
×0.5	Significant reduction in flood risk
×0.25	Large reduction in flood risk
×0.125	Very large reduction in flood risk
×0.0625	Extreme reduction in flood risk
×0.0312	Exceptional reduction in flood risk

Driver Impact Scoring (2)

Best estimate, Upper bound and Lower bound scores were entered into a specially written

Office of Science and Technology

Foresight in Flood and Coastal Defence

Phase 2, Package A - Deepening the assessment of Drivers of Future Flood Risk

Scenario 1 2050 World Markets

Driver name	Driver code	Driver Type (SIP/ or R)	Flood risk impact - Likelihood of flooding (for source and pathway drivers only)			Flood risk impact - Consequences of Flooding (for receptor drivers only)								Overall score		
						ECONOMIC				HEALTH AND SOCIAL						
			Upper	Best	Lower	Upper	Best	Lower	W1	Upper	Best	Lower	W2	Upper	Best	Lower
Risk compensation/Insurance	17	R							0.5				0.5	0	0	0
Regulation (influencing pathways)	5	P							0.5				0.5	0	0	0
Science, Engineering and Technology (as receptor)	23a	R							0.5				0.5	0	0	0
Science, Engineering and Technology (as pathway)	23b	P							0.5				0.5	0	0	0

Provisional scores were:

- *challenged at a 'Buy-in' meeting;*
- *revised by the relevant specialist teams;*
- *agreed by the whole team.*

Driver Ranking

- Science and Technology and Public Attitudes and Expectations excluded.
- Socio-economic drivers
- Big scenario differences
- Stakeholder behaviour *reduces* flood risk, in three out of four scenarios

Legend	Driver Impact Category	Risk Multiplier (M) Range	Colour Code
	High increase	$M \geq 2$	
	Medium increase	$2 > M \geq 1.2$	
	Low impact	$1.2 > M \leq 0.83$	
	Medium decrease	$0.83 \geq M \geq 0.5$	
	High decrease	$M < 0.5$	

Table 2.4b **National ranking of catchment-scale drivers – 2080s**

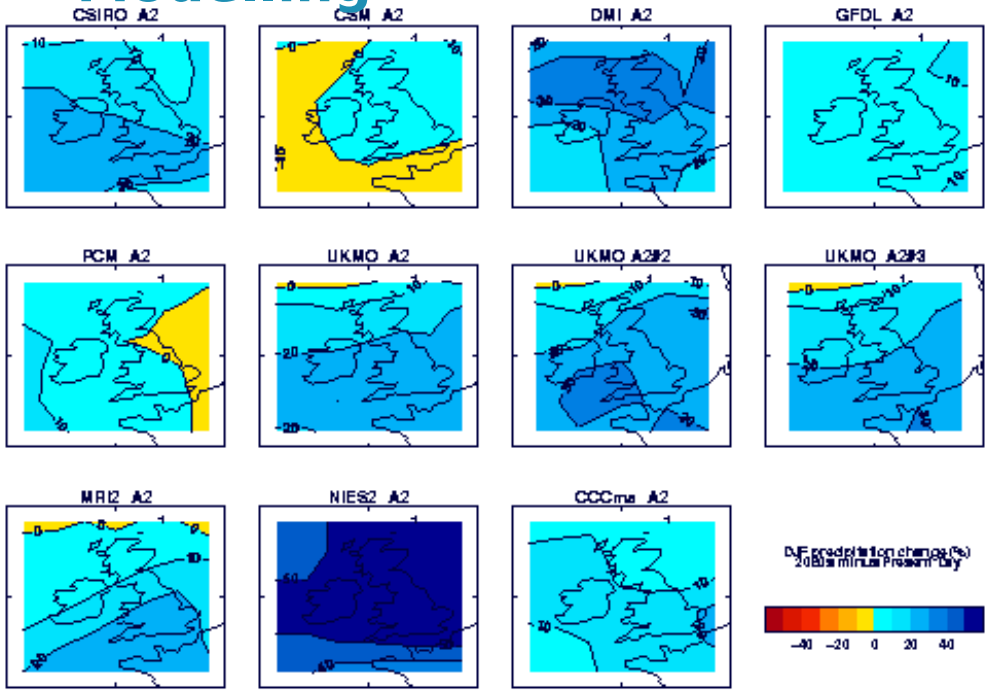
	World Markets	National Enterprise	Local Stewardship	Global Sustainability
	2080s	2080s	2080s	2080s
1	Social Impacts	Relative Sea Level Rise	Social Impacts	Environmental Regulation
2	Relative Sea Level Rise	Infrastructure Impacts	Relative Sea Level Rise	Relative Sea Level Rise
3	Surges	Surges	Environmental Regulation	Vegetation and Conveyance
4	Infrastructure Impacts	Buildings and Contents	Surges	Social Impacts
5	Buildings and Contents	Coastal Morphology and Sediment Supply	Precipitation	Precipitation
6	Coastal Morphology and Sediment Supply	Social Impacts	River Morphology and Sediment Supply	River Morphology and Sediment Supply
7	Waves	Precipitation	Coastal Morphology and Sediment Supply	Buildings and Contents
8	Precipitation	Urbanisation	Waves	Infrastructure Impacts
9	Stakeholder Behaviour	Waves	Vegetation and Conveyance	Coastal Morphology and Sediment Supply
10	Urbanisation	Urban Impacts	Urban Impacts	Surges
11	Urban Impacts	Rural land Management	Temperature	Urban Impacts
12	Rural land Management	Vegetation and Conveyance	Agriculture Impacts	Waves
13	River Morphology and Sediment Supply	Environmental regulation	Infrastructure Impacts	Temperature
14	Vegetation and Conveyance	River Morphology and Sediment Supply	Buildings and Contents	Agricultural Impacts
15	Temperature	Temperature	Urbanisation	Rural land Management
16	Agriculture Impacts	Agriculture Impacts	Rural land Management	Urbanisation
17	Environmental Regulation	Stakeholder Behaviour	Stakeholder Behaviour	Stakeholder Behaviour
	Science and Technology – known to be important but not quantified			
	Public Attitudes and Expectations – known to be important but not quantified			

Uncertainty Analysis

Specialists considered uncertainties arising from:

- Natural variability
- Data uncertainty
- Model uncertainty
- Knowledge uncertain

Example: Climate Change Modelling



Driver Uncertainty

- Expressed as the ratio of the upper bound estimate of driver impact to the lower bound estimate. High scorers:
- Relative sea level rise
- Coastal morphology
- Surges
- Precipitation
- Stakeholder behaviour

Legend	Uncertainty band category	Uncertainty band width (B) (B = ratio of upper to lower bound estimates of flood-risk impact multiplier)	Colour code
	High	B ≥ 3	
	Medium	3 > B ≥ 1.5	
	Low	1.5 > B	

Table 2.6b **Uncertainty in catchment-scale drivers ranked by national flood risk – 2080s**

	World Markets	National Enterprise	Local Stewardship	Global Sustainability
	2080s	2080s	2080s	2080s
1	Social Impacts	Relative Sea Level Rise	Social Impacts	Environmental Regulation
2	Relative Sea Level Rise	Infrastructure Impacts	Relative Sea Level Rise	Relative Sea Level Rise
3	Surges	Surges	Environmental Regulation	Vegetation and Conveyance
4	Infrastructure Impacts	Buildings and Contents	Surges	Social Impacts
5	Buildings and Contents	Coastal Morphology and Sediment Supply	Precipitation	Precipitation
6	Coastal Morphology and Sediment Supply	Social Impacts	River Morphology and Sediment Supply	River Morphology and Sediment Supply
7	Waves	Precipitation	Coastal Morphology and Sediment Supply	Buildings and Contents
8	Precipitation	Urbanisation	Waves	Infrastructure Impacts
9	Stakeholder Behaviour	Waves	Vegetation and Conveyance	Coastal Morphology and Sediment Supply
10	Urbanisation	Urban Impacts	Urban Impacts	Surges
11	Urban Impacts	Rural Land Management	Temperature	Urban Impacts
12	Rural Land Management	Vegetation and Conveyance	Agriculture Impacts	Waves
13	River Morphology and Sediment Supply	Environmental Regulation	Infrastructure Impacts	Temperature
14	Vegetation and Conveyance	River Morphology and Sediment Supply	Buildings and Contents	Agriculture Impacts
15	Temperature	Temperature	Urbanisation	Rural Land Management
16	Agriculture Impacts	Agriculture Impacts	Rural Land Management	Urbanisation
17	Environmental Regulation	Stakeholder Behaviour	Stakeholder Behaviour	Stakeholder Behaviour
	Science and Technology – known to be important but not quantified			
	Public Attitudes and Expectations – known to be important but not quantified			

Intra-urban drivers

- Separate analysis in 2004 study with Driver Groups covering:
  - Climate Change,
  - Runoff,
  - Urban Conveyance Systems & Processes,
  - Human Behaviour,
  - Socio-economics
- All similar to main Driver set, except Urban Conveyance Systems/Processes. This covers various intra-urban impacts mainly those on urban pipe networks and water courses.

Table 3.1 Driver groups in the intra-urban zone

Driver group	Driver	SPR classification	Explanation
Climate change	Precipitation	Source	Changes in short-duration precipitation – amount, intensity, duration, location, seasonality and clustering
Runoff	Urbanisation	Pathway	A change in land management with green field and pervious surfaces covered by less-pervious materials (buildings and infrastructure) and associated new conveyance systems
	Management of Peri-Urban Rural Land	Pathway	Changes in the management of land adjacent to the urban area that influence runoff into the urban area, for example, muddy floods
Urban conveyance systems and processes	Environmental Management and Regulation	Pathway	The management of the green areas within the urban landscape, including flora and fauna
	Urban Watercourse Conveyance, Blockage and Sedimentation	Pathway	Processes associated with above-ground overland surface flow in natural watercourses and man-made systems, including performance, maintenance and operation
	Sewer Conveyance, Blockage and Sedimentation	Pathway	As above, but associated with processes that occur in below-ground drainage systems
	Impact of External Flooding on Intra-urban Drainage Systems	Pathway	Loss of conveyance and serviceability in below-ground drainage systems due to flooding from external sources
	Intra-urban Asset Deterioration	Pathway	Changes in the performance, condition and serviceability of urban drainage assets (ageing, performance wear-and-tear and rehabilitation management)
Human behaviour	Stakeholder Behaviour	Pathway	Mechanisms to ensure that all stakeholder interests are accommodated
	Public Attitudes and Expectations	Receptor	Taking due regard of the interests of the public, their views, beliefs, attitudes and values
Socio-economics	Buildings and Contents	Receptor	Accounting for the cost of flood damage to households
	Urban Impacts	Receptor	The potential to classify the risk of flooding in urban areas
	Infrastructure Impacts	Receptor	The impact on the performance, serviceability and economics of the drainage infrastructure due to a flood event
	Social Impacts	Receptor	The value to society of a flood event, primarily intangible, excluded by economic assessment
	Science and Technology	Receptor	Application and design of the outputs of scientific and technological research

Responses to Future Flood Risk

Analytical framework similar to that for Drivers:

- Response themes and groups
- Response scoring and ranking
- Uncertainty Ana

Response themes and groups

Response Theme	Groups	Measures
Managing the Rural Landscape (P)		Rural Infiltration
	Catchment-Wide Storage	
	Rural Conveyance	13
Managing the Urban Fabric (P)		Urban Storage
	Urban Infiltration	
	Urban Conveyance	20
Managing Flood Events (P+R)		Pre-Event Measures
	Forecasting and Warning	Flood fighting
	Collective Damage Avoidance	
	Individual Damage Avoidance	14

P = affects pathway drivers ***R = affects receptor drivers***

Response themes and groups

Future Flooding

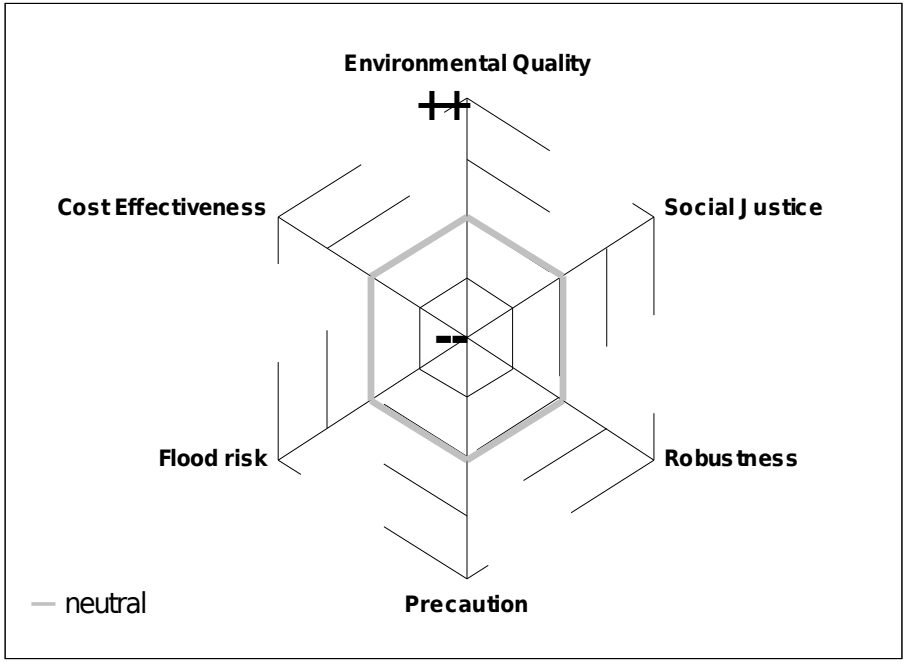
Response Theme	Groups	Measures
Managing Flood Losses (R)	Land use Planning and Management	
	Flood-proofing Buildings	
	Facilitate Economic &Financial Recovery	
	Lessen the Health, Social & Practical Impacts	15
River, Coastal & Estuary Engineering (P)	River Conveyance	
	Engineered Storage	
	Flood Water Transfer	
	River Defences	
	Coastal Defences	
	Realign Coastal Defences	
	Abandon Coastal Defences	
	Reduce Coastal Energy	
	Morphological Coastal Protection	18
TOTALS	**26**	**80**

Response themes and groups: mapping to Gilbert F White's "adjustments"

Response Theme – proposed "adjustments"	Gilbert F White's (1942) 8
Managing the Rural Landscape (P)	Flood Abatement
Managing the Urban Fabric (P)	?
Managing Flood Events (P+R)	Emergency Measures
Managing Flood Losses (R)	Elevation (land or buildings)
	Structural Alterations (buildings)
	Land Use planning
	Relief for victims
	Insurance
River, Coastal & Estuary Engineering (P)	Flood Protection

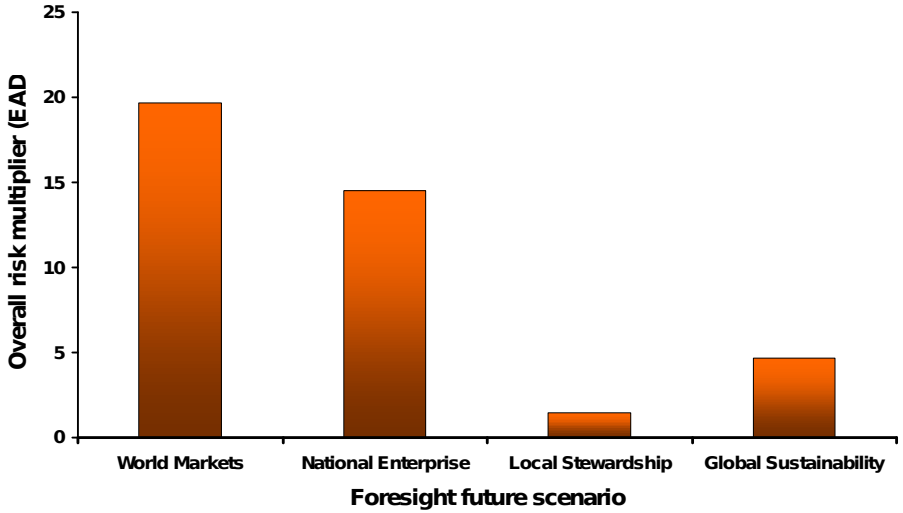
Deep Response Descriptions

- Definition, Function and Efficacy
- Governance
- ***Sustainability***
- Costs
- Interactions
- Case example
- Emerging issues
- Uncertainty
- ***Potential for implementation under each of the four Foresight future scenarios***



Response Impact Scoring

National flood risk multiplier scores for the 2080s				
	World Markets	National Enterprise	Local Stewardship	Global Sustainability
Overall risk multiplier	19.7	14.5	1.44	4.67



Risk Multiplier Score (S)

$$S = \frac{\text{national risk in 2080s with response implemented}}{\text{national risk in 2080s under baseline assumption}}$$

Response Ranking

- River and Coastal Defences
- Land use Planning and Management
- Flood proofing buildings

Legend

Colour code	Interpretation
	Major reduction in flood risk (S < 0.7)
	Marked reduction in flood risk (0.7 < S < 0.9)
	Minor reduction in flood risk (0.9 < S <1.0)
	Ineffective (S =1)
	Likely to Increase flood risk (S >1.0)

Responses Groups ranked by potential risk reduction in the 2080s

Rank	World Markets	National Enterprise	Local Stewardship	Global Sustainability
1	River Defences	River Defences	Land Use Planning and Management	Land Use Planning and Management
2	Coastal Defences	Coastal Defences	Flood Proofing Buildings	Catchment-Wide Storage
3	Flood Proofing Buildings	Reduce Coastal Energy	Individual Damage Avoidance	River Defences
4	Reduce Coastal Energy	Realign Coastal Defences	River Defences	Coastal Defences
5	Morphological Coastal Protection	Morphological Coastal Protection	Catchment-Wide Storage	Flood Proofing Buildings
6	Realign Coastal Defences	Coastal Defence Abandonment	Pre-event Measures	Rural Conveyance
7	Real-time Event Management	Flood Proofing Buildings	Real-time Event Management	Realign Coastal Defences
8	River Conveyance	River Conveyance	Engineered Flood Storage	Reduce Coastal Energy
9	Individual Damage Avoidance	Catchment-Wide Storage	Rural Conveyance	Morphological Coastal Protection
10	Pre-event Measures	Land Use Planning and Management	River Conveyance	Engineered Flood Storage
11	Engineered Flood Storage	Engineered Flood Storage	Rural Infiltration	Real-time Event Management
12	Land Use Planning and Management	Real-time Event Management	Manage Urban Runoff	Pre-event Measures
13	Manage Urban Runoff	Pre-event Measures	Flood Water Transfer	Individual Damage Avoidance
14	Flood Water Transfer	Rural Conveyance	Coastal Defences	River Conveyance
15	Catchment-Wide Storage	Rural Infiltration	Realign Coastal Defences	Rural Infiltration
16	Rural Conveyance	Individual Damage Avoidance	Morphological Coastal Protection	Manage Urban Runoff
17	Rural Infiltration	Manage Urban Runoff	Reduce Coastal Energy	Flood Water Transfer
18		Flood Water Transfer	Coastal Defence Abandonment	

Response Uncertainty

- Land use planning and management
- Flood proofing
- River and coastal defences

Legend

Colour code	Uncertainty Band Width (B) (B = ratio of upper to lower bound estimates of flood risk impact multiplier)
	B > 1.5
	1.5 > B > 1.1
	B < 1.1

Uncertainty in Responses Groups in the 2080s				
Rank	World Markets	National Enterprise	Local Stewardship	Global Sustainability
1	River Defences	River Defences	Land Use Planning and Management	Land Use Planning and Management
2	Coastal Defences	Coastal Defences	Flood Proofing Buildings	Catchment-Wide Storage
3	Flood Proofing Buildings	Reduce Coastal Energy	Individual Damage Avoidance	River Defences
4	Reduce Coastal Energy	Realign Coastal Defences	River Defences	Coastal Defences
5	Morphological Coastal Protection	Morphological Coastal Protection	Catchment-Wide Storage	Flood Proofing Buildings
6	Realign Coastal Defences	Coastal Defence Abandonment	Pre-event Measures	Rural Conveyance
7	Real-time Event Management	Flood Proofing Buildings	Real-time Event Management	Realign Coastal Defences
8	River Conveyance	River Conveyance	Engineered Flood Storage	Reduce Coastal Energy
9	Individual Damage Avoidance	Catchment-Wide Storage	Rural Conveyance	Morphological Coastal Protection
10	Pre-event Measures	Land Use Planning and Management	River Conveyance	Engineered Flood Storage
11	Engineered Flood Storage	Engineered Flood Storage	Rural Infiltration	Real-time Event Management
12	Land Use Planning and Management	Real-time Event Management	Manage Urban Runoff	Pre-event Measures
13	Manage Urban Runoff	Pre-event Measures	Flood Water Transfer	Individual Damage Avoidance
14	Flood Water Transfer	Rural Conveyance	Coastal Defences	River Conveyance
15	Catchment-Wide Storage	Rural Infiltration	Realign Coastal Defences	Rural Infiltration
16	Rural Conveyance	Individual Damage Avoidance	Morphological Coastal Protection	Manage Urban Runoff
17	Rural Infiltration	Manage Urban Runoff	Reduce Coastal Energy	Flood Water Transfer
18		Flood Water Transfer	Coastal Defence Abandonment	

2008 re-run of quantitative analysis

Future Flooding

Drivers

- What did we do differently?

- Merged intra-urban responses with main driver set and some other regrouping of drivers (according to S-P-R) to permit a coherent overall ranking
- Added driver group on groundwater systems and processes
- Evaluated all post-2004 evidence and described changes to drivers
- Re-scored and re-ranked all drivers, but only if new evidence (expert not allowed just to 'change their mind'). Examples of things to note:
  - Intra-urban divers come in with mid (2050s) to high (2080s) ranking.
  - Precipitation moves up ranking tables
  - Agricultural impacts much more significant at a local level, but at a national scale they are still negligible.

2008 re-run of quantitative analysis - what did we do differently?

Responses

- Combined intra-urban responses with main response set. Most were similar but six new responses (below) – enabled a coherent overall ranking.

Managing the urban fabric (b) reducing intra-urban and coincident flood probability within the urban area	**Building development, operation and form**
	Urban area development, operation and form
	Source control
	Groundwater control
	Storage above and below ground
	Main drainage form, maintenance and operations

- Evaluated all post-2004 evidence and described changes to drivers
- All drivers re-scored and re-ranked.

2008 re-run of quantitative analysis - what did we do differently?

Responses (contd): Outcomes of re-ranking

- Very little change in risk reduction scores, despite careful re-evaluation of new evidence since 2004
- Only effectiveness scores to change were ‘Land Use Management &Planning’ and ‘Flood proofing buildings/building codes’, moving their relative ranking either up or down depending on the scenario
- **Intra-urban responses (not in GF White list) enter in the top half of the response ranking tables.**

Response Ranking (2008 revision)

- Revised coherent ranking
- Notice high ranking of intra-urban drivers

Legend

Colour code	Interpretation
	Major reduction in flood risk (S < 0.7)
	Marked reduction in flood risk (0.7 < S < 0.9)
	Minor reduction in flood risk (0.9 < S <1.0)
	Ineffective (S =1)
	Likely to Increase flood risk (S >1.0)

	World Markets	National Enterprise	Local Stewardship	Global Sustainability
1	River Defences	River Defences	Land Use Planning and Management	Building Development, Operation and Form
2	Coastal Defences	Coastal Defences	Flood-Proofing Buildings	Urban Area Development, Operation and Form
3	Reduce Coastal Energy	Reduce Coastal Energy	Urban Source Control and Above-Ground Pathways	Urban Source Control and Above-Ground Pathways
4	Coastal Defence Realignment	Coastal Defence Realignment	Individual Damage Avoidance	Urban Storage Above and Below Ground
5	Morphological Coastal Protection	Morphological Coastal Protection	River Defences	Land Use Planning and Management
6	Flood-Proofing Buildings	Coastal Defence Abandonment	Catchment-Wide storage	Catchment-Wide storage
7	Urban Area Development, Operation and Form	Main Drainage Form, Maintenance and Operation	Building Development, Operation and Form	River Defences
8	Urban Source Control and Above-Ground Pathways	Flood-Proofing Buildings	Urban Area Development, Operation and Form	Coastal Defences
9	Urban Storage Above and Below Ground	River Conveyance	Urban Storage Above and Below Ground	Flood-Proofing Buildings
10	River Conveyance	Catchment-Wide storage	Pre-Event measures	Rural Conveyance
	Pre-Event measures	Engineered Flood	Real-Time Event	Coastal Defence

Discussion